

**2004 GALVESTON BAY INVASIVE SPECIES RISK ASSESSMENT
INVASIVE SPECIES SUMMARY**

Created by: Environmental Institute of Houston, University of Houston-Clear Lake
and the Houston Advanced Research Center

Common Name: Eurasian watermilfoil, spike watermilfoil																																															
Latin Name: <i>Myriophyllum spicatum</i>																																															
Category: Aquatic Plant																																															
Place of Origin: Native to Europe and North Africa																																															
Place of Introduction: Unknown																																															
Date of Introduction: 1900 or earlier http://www.wes.army.mil/el/pmis/plants/html/myrioph3.html (Accessed 19 March 2003)																																															
States Effected: <table border="0"> <tr> <td>Alabama</td><td>Georgia</td><td>Massachusetts</td><td>New Jersey</td><td>Pennsylvania</td><td>Washington</td></tr> <tr> <td>Alaska</td><td>Illinois</td><td>Michigan</td><td>New Mexico</td><td>South Carolina</td><td>Wisconsin</td></tr> <tr> <td>Arkansas</td><td>Indiana</td><td>Minnesota</td><td>New York</td><td>Tennessee</td><td></td></tr> <tr> <td>California</td><td>Iowa</td><td>Mississippi</td><td>North Carolina</td><td>Texas</td><td></td></tr> <tr> <td>Connecticut</td><td>Kentucky</td><td>Missouri</td><td>North Dakota</td><td>Utah</td><td></td></tr> <tr> <td>Delaware</td><td>Louisiana</td><td>Nebraska</td><td>Ohio</td><td>Vermont</td><td></td></tr> <tr> <td>Florida</td><td>Maryland</td><td>New Hampshire</td><td>Oklahoma</td><td>Virginia</td><td></td></tr> </table> http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=MYSP2						Alabama	Georgia	Massachusetts	New Jersey	Pennsylvania	Washington	Alaska	Illinois	Michigan	New Mexico	South Carolina	Wisconsin	Arkansas	Indiana	Minnesota	New York	Tennessee		California	Iowa	Mississippi	North Carolina	Texas		Connecticut	Kentucky	Missouri	North Dakota	Utah		Delaware	Louisiana	Nebraska	Ohio	Vermont		Florida	Maryland	New Hampshire	Oklahoma	Virginia	
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Life History: <p>“The growing stem tips of Eurasian watermilfoil (and other milfoil species) are tassel-like and often red; especially early in the growing season. Tiny pinkish flowers occur on reddish spikes that stand several inches above the water and submerge when pollination is complete. The stem width of Eurasian watermilfoil almost doubles below the inflorescence. Lower flowers are pistillate, upper flowers staminate. Seeds are produced, but seedlings are rare in nature. In situations where water evaporates slowly and the plants gradually become stranded, Eurasian watermilfoil can develop into a land form. The leaves of the land form are smaller, stiffer, and have fewer divisions. If such plants are submerged, new growth with aquatic leaves develops in 7-10 days, but the first leaves formed have relatively few divisions and only later does the number of divisions increase to more than 12 leaflet pairs.”</p> http://www.wapms.org/plants/milfoil.html (Accessed 19 March 2003).																																															
Growth/Size: <p>2. “Plants grow beneath the surface of the water, rooted in the substrate. The upper flower-bearing portion of the stem is above the surface of the water. Plants of this species never form turions but in colder climates die back to the root crowns over winter. The species is rhizomatous, branches freely and forms dense mats upon or near the surface of the water. Plants root at the nodes; vegetative fragments may form new plants.” http://www.wes.army.mil/el/pmis/plants/html/myrioph3.html (Accessed 19 March 2003).</p>																																															
Feeding Habits/Diet: NA																																															
Habitat: <p>“Tolerates moderate salinity, grows in lower estuary areas” http://www.apms.org/plants/milfoil.htm (Accessed 19 March 2003).</p> <p>“This species is known to occur in a variety of habits, becoming established in both impoundments and natural waters, sometimes brackish water or in clear, cool, spring-fed rivers.” http://www.wes.army.mil/el/pmis/plants/html/myrioph3.html (Accessed 19 March 2003).</p> <p>“Eurasian watermilfoil is an extremely adaptable plant, able to tolerate and even thrive in a variety of environmental conditions. It grows in still to flowing waters, can tolerate salinity's of up to 15 parts per thousand (half the salinity of Puget Sound in Washington), grows rooted in water depths from 1 to 10 meters (regularly reaching the surface while growing in water 3 to 5 meters deep), and can survive under ice. It is able to tolerate pHs from 5.4-11. Relative to other submersed plants, Eurasian watermilfoil requires high light, has a high photosynthetic rate, and can grow over a broad temperature range. Eurasian watermilfoil grows best on fine-textured, inorganic sediments and relatively poorly on highly organic sediments. Over the spectrum of infertile to enriched aquatic systems, Eurasian watermilfoil appears to prefer an approximate mid-point, although it occurs in ultra-oligotrophic lakes like Lake Tahoe in California and Lake Chelan in Washington and in hyper-eutrophic lakes.” http://www.wapms.org/plants/milfoil.html (Accessed 19 March 2003).</p>																																															

Attitude (aggressive, etc.):

“Major nuisance aquatic plant in US, southern Canada (\$5M/yr in central New York)” <http://www.apms.org/plants/milfoil.htm> (Accessed 19 March 2003).

“The rapid growth rate of this species allows it to cover water surfaces and displace native vegetation.” <http://www.wes.army.mil/el/pmis/plants/html/myrioph3.html> (Accessed 19 March 2003).

“Eurasian watermilfoil adversely impacts aquatic ecosystems by forming dense canopies that often shade out native vegetation. Monospecific stands of Eurasian watermilfoil provide poor habitat for waterfowl, fish, and other wildlife. Significant rates of plant sloughing and leaf turnover, as well as the decomposition of high biomass at the end of the growing season, increase the internal loading of phosphorus and nitrogen to the water column. Dense Eurasian watermilfoil mats alter water quality by raising pH, decreasing oxygen under the mats, and increasing temperature. Eurasian watermilfoil impacts power generation and irrigation by clogging dam trash racks and intake pipes. Stagnant water created by Eurasian watermilfoil mats provides good breeding grounds for mosquitoes. Eurasian watermilfoil interferes with recreational activities such as swimming, boating, fishing and water skiing. In Washington State, private and government sources spend about \$1,000,000 per year on Eurasian watermilfoil control. Other states and provinces (Minnesota, Wisconsin, Vermont, New York, and British Columbia) spend similar amounts per year to control Eurasian watermilfoil infestations.” <http://www.wapms.org/plants/milfoil.html> (Accessed 19 March 2003).

Physical Description:

“Mostly evergreen perennial; overwinters by root crown, aerial wind -pollinated flowers, spread by runners and autofragments” <http://www.apms.org/plants/milfoil.htm> (Accessed 19 March 2003).

“Stem thickened below the inflorescence to almost double the width of the lower stem, usually curved to lie parallel with the water surface; scales at the inflorescence nodes 2-3, black, distinct in fresh material; plants never forming turions, dying back to root crowns over winter.” <http://www.wes.army.mil/el/pmis/plants/html/myrioph3.html> (Accessed 19 March 2003).

Management Recommendations / Control Strategies: include references for existing site-specific strategies

Response to Herbicides

Westerdahl and Getsinger report excellent control with 2,4-D, diquat, diquat and complexed copper, endothall dipotassium salt, and endothall and complexed copper. They report good control with fluridone. In Washington, fluridone (brand name Sonar®) has been successfully used to eradicate Eurasian watermilfoil in Long Lake, Thurston County and in other western Washington lakes. To be effective, fluridone concentrations of 10-15 ppb must be maintained in the water column for 10 to 12 weeks. Follow-up diver surveillance and hand-pulling of surviving plants is essential to the success of this technique. Some eradication attempts with fluridone have had mixed success in Washington. Factors such as surface and ground water inflows and development of land forms of Eurasian watermilfoil all affect the success rate. The herbicide triclopyr is undergoing federal aquatic registration and holds great promise for Eurasian watermilfoil control. Unlike fluridone, triclopyr requires a short contact time (18 to 48 hours) and will selectively control Eurasian watermilfoil while leaving many native aquatic plants relatively unaffected.

Response to Cultural Methods

Localized control (in swimming areas and around docks) can be achieved by covering the sediment with a opaque fabric which blocks light from the plants (bottom barriers or screens). Managers of reservoirs and some lake systems may have the ability to lower the water level as a method of managing aquatic plants. The Tennessee Valley Authority (TVA) uses both winter and summer water level draw-downs as effective way of reducing Eurasian watermilfoil biomass. They find that a drawdown of about 2 meters is effective in reducing excessive populations. Short-term dewatering for 2-3 days during period of freezing temperatures has been effective, but multiple exposures may improve control. A 1-week drawdown of a large TVA impoundment in July 1983 desiccated about 810 hectares of Eurasian watermilfoil. A narrow, relatively weed-free band occurred after refilling and control effects extended into the following two growing seasons. In Washington, the Bureau of Reclamation lowered the water level of Banks Lake in 1994 in an effort to manage Eurasian watermilfoil populations. The success of a drawdown on Eurasian watermilfoil is dependent on several factors such as degree of desiccation (draw-downs in rainy western Washington and Oregon are often ineffective), the composition of substrate (sand vs. clay), air temperature (the exposed sediments need to freeze down to 8-12 inches), and presence of snow.

Response to Mechanical Methods

Because this plant spreads readily through fragmentation, mechanical controls such as cutting, harvesting, and rotovation (underwater rototilling) should be used only when the extent of the infestation is such that all available niches have been filled. Using mechanical controls while the plant is still invading, will tend to enhance its rate of spread.

Rotovation: The British Columbia Ministry of Environment developed a barge mounted rototilling machine called a rotovator to

remove Eurasian watermilfoil roots. Underwater tiller blades churn up to 8 inches into the sediment and dislodge buoyant Eurasian watermilfoil roots. Floating roots may then be collected from the water. Control with rotovation, generally extends 2 or more growing seasons.

Harvesting: Harvesting can be compared to underwater lawn mowing. Plants are cut generally 5 feet below the water's surface, collected by conveyor, and stored until disposal on land. Harvesting removes surfacing mats and creates open areas of water. However because of its rapid growth rate Eurasian watermilfoil generally needs to be harvested twice during the growing season.

Cutting: Cutting is similar to harvesting except cut plants are not picked up from the water by the cutting machine. Washington requires that cut plants be removed from the water.

Biocontrol Potentials

Insects: The United States Department of Agriculture in conjunction with the Army Corps of Engineers have carried out searches for Eurasian watermilfoil biological control agents in Pakistan, Bangladesh, China, Korea, and Yugoslavia. Several insects have been evaluated, including a number of pyralid moths and several stem-boring weevils. However, many of these insects were found to be non-specific to Eurasian watermilfoil or to offer little potential as effective biological control agents. In British Columbia, several insects were associated with Eurasian watermilfoil and a midge was investigated as a potential control agent. However, the midge proved to be extremely difficult to rear in the laboratory. The North American weevil, *Euhrychiopsis lecontei* (Dietz) has been found associated with declining populations of Eurasian watermilfoil in northeastern North America. *Euhrychiopsis lecontei* has been found in Washington state feeding on both Eurasian watermilfoil and northern milfoil (*Myriophyllum sibiricum*) plants. Studies have shown that this native weevil appears to be a milfoil specialist and will not feed on other macrophyte species. It can be easily raised in the laboratory and laboratory-reared weevils could be used to augment natural populations, as is being tried in Vermont and Wisconsin.

Grass Carp: Although triploid grass carp will eat Eurasian watermilfoil, it is not a highly palatable or preferred species. To achieve control of Eurasian watermilfoil generally means the total removal of more palatable native aquatic species before the grass carp will consume Eurasian watermilfoil. In situations where Eurasian watermilfoil is the only aquatic plant species in the lake, this may be acceptable. However, generally grass carp are not recommended for Eurasian watermilfoil control.

Plant Pathogens: Interest in pathogens of Eurasian watermilfoil was stimulated by extensive mortality of Eurasian watermilfoil in Lake Venice and the Northeast River, Maryland in the late 1960s. At that time, the declines (called Northeast Disease) were suspected to be caused by a pathogen, although no pathogens were ever isolated. However Northeast Disease stimulated research into the use of plant pathogens for biological control. The plant pathogenic fungus *Mycoleptodiscus terrestris* has been shown to significantly reduce Eurasian watermilfoil biomass in laboratory studies. A commercial biotechnology firm spent several years developing this fungus as a biological tool to control Eurasian watermilfoil, but was unable to achieve control of the plant in field settings. The US Army Corps of Engineers is continuing research on plant pathogens." <http://www.wapms.org/plants/milfoil.html> (Accessed 19 March 2003).

Agencies Collecting Data:

Gulf of Mexico Program
University of Florida

References (includes journals, agency/university reports, and internet links):

1. APMS - <http://www.apms.org/plants/milfoil.htm> (Accessed 19 March 2003).
2. STPL - <http://www.wes.army.mil/el/pmis/plants/html/myrioph3.html> (Accessed 19 March 2003)
3. NAPIS - <http://www.ceris.purdue.edu/napis/pests/ewm/index.html> (Accessed 19 March 2003)
4. WAPMS - <http://www.wapms.org/plants/milfoil.html> (Accessed 19 March 2003)
5. PCA - <http://www.nps.gov/plants/alien/fact/mysp1.htm>

Available Mapping Information:

PLANTS - http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=MYSP2
STPL - <http://www.wes.army.mil/el/pmis/plants/html/myrioph3.html>
NAPIS - <http://www.ceris.purdue.edu/napis/pests/ewm/mgif/ewmall.gif>
PCA - <http://www.nps.gov/plants/alien/map/mysp1.htm>